Expert Refinement of Data-Derived Bayesian Networks for Medical Diagnosis

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INTRODUCTION AND BACKGROUND

We present examples of how medical expertise can be used to refine Bayesian networks that are generated from data. Our areas of interest, magnetic resonance imaging (MRI) and magnetic resonance spectroscopy (MRS), are in their infancy for many clinical applications. Although it is clear that the biochemical changes detected with MRS correlate with a variety of pathophysiological states, the exact relationship of these changes to clinical diagnoses is largely unknown. Similarly, the prognostic significance of MRI findings has not been well delineated for many clinical entities. In contrast, there is considerable clinical expertise regarding physical findings, historical information, and therapy for many disorders in which MRI/MRS may play a diagnostic role. This dichotomy is reflected in our paradigm for constructing expert systems that incorporate magnetic-resonance (MR) data.

METHODS

First, we employ a standard machine-learning algorithm for generating a Bayesian network from a database that includes MR variables. Then, we present the resulting expert system to a clinical expert, who refines the Bayesian network by adding or deleting arcs or nodes using a graphical user interface. This refinement reflects the expert's knowledge of the clinical entities (with or without associated MR characteristics), as well as relevant information obtained from the literature. By comparing the results of inference on a set of test cases, we show the advantage of a refined Bayesian-network over a purely data-derived network.

CONCLUSIONS

Expert refinement of data-derived Bayesian networks results in improved knowledge representation over purely data-derived networks. This feature of Bayesian systems is particularly advantageous in bridging human and literature-based expertise with MR data.

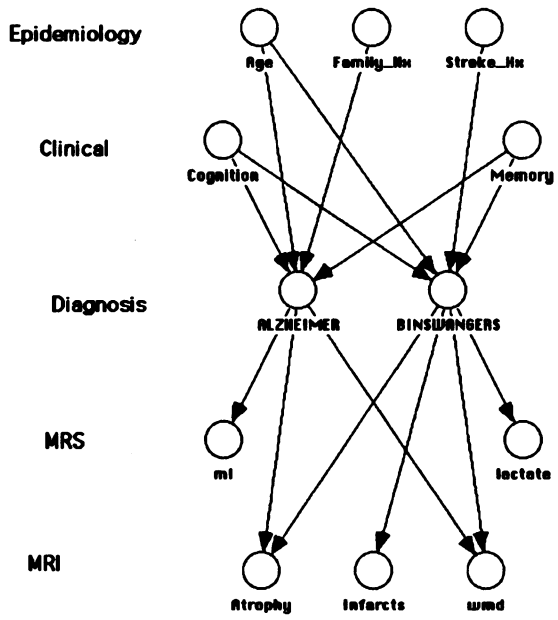

Figure 1. Belief subnetwork for dementia. Hx = history, mI= myoinositol peak, wmd = white matter disease .